REMOTE DIAGNOSTIC TOOL FOR A MEDIA DELIVERY NETWORK

FIELD OF THE INVENTION

The present invention generally relates to a media delivery service system. More particularly, the present invention relates to enabling the remote diagnosis of components within a media delivery service system.

BACKGROUND OF INVENTION

More than ever before, residential consumers are being provided with a wealth of media resources. While cable television, the Internet, and on-demand media have been available for years, recently developed high-speed broadband technologies are enhancing the delivery of these media services. These technologies have made it possible to increase the variety of available media services and to enhance the ability of the user to interact with the media delivery system to tailor media delivery to the user's preferences. Satellite communications, asymmetric digital subscriber lines (ADSL), and broadband cable are providing new high-throughput connections to media delivery services. Media services consumers are

commonly establishing wireless connections to satellites, telephony-based connections to ADSL, and broadband cable connections to the media service providers. Typically, these connections are processed by a Media Distribution Device that processes media content and data and routes the media and/or data to media presentation devices, such as a television or personal computer. A conventional Set-top Box is an example of a Media Distribution Device.

Unfortunately, because these high-speed media delivery technologies are so new, customers often have trouble establishing and maintaining a properly functioning media delivery system. Typical problems include low signal strengths, bit error rates, problems with physical connections between devices in the media delivery system, and compatibility problems. Often, the Media Distribution Device will be connected to other devices such as a hub, a personal computer, a television, or another Media Distribution Device. When capability issues arise between these devices, the performance of the entire media delivery system can be adversely affected. Compatibility problems can be caused by hardware, software, or other means. Moreover, most customers are not technically savvy enough to troubleshoot the problems on their own.

Traditionally, customer problems are addressed by providing a telephone-based technical support line or by providing an onsite technician service call. The typical technical support call involves having the customer describe the system configuration. For example, in the case of an ADSL Internet customer, the technical support technician may ask the customer to verify that the customer's personal computer has the requisite hardware and

software configuration to communicate with an ADSL modem. The technical support technician will often ask the customer to execute various diagnostic procedures. If the technical support diagnosis fails, an onsite technician service call will normally be provided. The on-site technician will troubleshoot the system and attempt to place the media delivery system in an operational condition.

Both technical support line technicians and on-site technicians are very expensive resources. For example, technical support cost studies indicate that it costs about as much to send a technician to perform an on-site service call as a customer pays for one or two month's worth of services. Accordingly, technical support service calls negatively affect the profitability of a media distribution service provider and are to be avoided.

Another problem with on-site technical service calls relates to the behavior of the service call technicians. Often, service call technicians are over-booked and are pressured to complete a service call in a very limited amount of time. Consequently, service technicians are prone to replace a Media Distribution Device, rather than to troubleshoot and/or repair an existing Media Distribution Device. Studies indicate that only about 5% of Media Distribution Devices that are returned by service call technicians are actually defective. Usually, returned Media Distribution Devices are simply improperly configured. Returning Media Distribution Devices to a manufacturer, especially when the Media Distribution Device is not actually defective, is extremely expensive. Therefore, there is a need to minimize service calls and all other interaction between customers and service personnel, because such interaction is expensive. In addition, there

is a need to troubleshoot and repair Media Distribution Devices in the field, rather than swapping them with new Media Distribution Devices.

One approach to solving this problem has been to install self-diagnostic tools on the Media Distribution Device. Unfortunately, there are several shortcomings to this approach. Conventional Media Distribution Devices have been equipped with a slow (low bandwidth) trouble-shooting connection, such as a 2400-baud modem. This connection allows a technician to upload data from the Media Distribution Device to a service center for troubleshooting. Unfortunately, the connection is slow and, therefore, service technicians are prone to avoid using the connection. In addition, the slow connection cannot provide real-time diagnostic functionality, but can only provide historical performance data, which is less valuable for trouble-shooting. Moreover, many customers disconnect the modem connection from their telephone lines, thereby requiring an on-site technician service call to connect the modem for uploading data.

Another problem with the installation of self-diagnostic tools is that memory is one of the most expensive parts of a conventional Media Distribution Device. Consequently, any self-diagnostic application that is installed in the memory of the Media Distribution Device must be small, so as to minimize the use of the memory resources. Because the conventional self-diagnostic application is small, it cannot be very sophisticated. Typically, such self-diagnostic applications have not been comprehensive diagnostic tools and aren't sophisticated enough to direct a customer through a comprehensive troubleshooting procedure. Similarly, in the satellite distribution context, transponder space is very valuable. Using transponder

resources for self-diagnostic applications is, therefore, expensive and heretofore cost prohibitive.

Therefore, there is a need in the art for a media delivery system diagnostic tool that provides for remote, high-speed, realtime system diagnosis. The tool should provide for system diagnosis to be performed by a central service center in communication with a local intelligent diagnostic agent. The tool should be readily accessible during off-peak times for automated diagnostics and Media Distribution Device system software updating. The tool also should permit the temporary installation of diagnostic software for troubleshooting and the subsequent removal of that software to conserve valuable memory resources.

SUMMARY OF THE INVENTION

A media delivery diagnostic system can be deployed in response to a customer complaint or in an autonomous fashion. When a customer complains to a media delivery service provider, the complaint can be passed to a diagnostic service center. The diagnostic service center can initiate a query or command and transmit the query or command to a Media Distribution Device (MDD). The query or command can be processed by an intelligent diagnostic agent residing in the MDD. When the intelligent diagnostic agent receives the query or command, it can perform a diagnostic evaluation of the MDD and any other devices connected to the MDD. The intelligent diagnostic agent can transmit diagnostic data back to the diagnostic service center. The diagnostic data may be operational data and/or operational parameters related to the MDD, the identification of a

problem with the MDD, or an indication that the intelligent diagnostic agent failed to identify a problem in the MDD. In response to the receipt of diagnostic data from the MDD, the diagnostic service center can send a supplemental query or command to instruct the intelligent diagnostic agent to perform a remedial action.

Remedial actions may include the replacement of the intelligent diagnostic agent or the replacement of another program module stored in the system memory of the MDD. Alternatively, the remedial action may require a service call to the physical location of the media distribution device. Thus, the media delivery system can be self-diagnosing, in that a performance problem can be automatically identified and remedied in a media distribution device. Advantageously, the use of a broadband communication link between the media distribution service provider and the media delivery device enables such self-diagnosis to be performed in real-time, during off-peak use hours, and with little adverse impact on overall system performance.

The various aspects of the present invention may be more clearly understood and appreciated from a review of the following detailed description of the disclosed embodiments and by reference tothe drawings and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a block diagram of an exemplary operating environment in which embodiments of the present invention may be implemented.

Figure 2 is a block diagram depicting some of the primary components of an exemplary Media Distribution Device.

Figure 3 is a block diagram depicting a media delivery diagnostic system that is an exemplary embodiment of the present invention.

Figure 4 is a flow chart depicting an exemplary method for providing remote media delivery system diagnosis.

DETAILED DESCRIPTION

Figure 1 is a block diagram of an exemplary operating environment in which embodiments of the present invention may be implemented. Media content is typically delivered to a customer by means of a Media Distribution Device **100**. The most common Media Distribution Devices are conventional Set-Top Boxes (STBs). The Media Distribution Device (MDD) **100** can provide media content and/or data to a media presentation device **101** over a communication link **102**. The most common example of a media presentation device **101** is a conventional television. Typically, the MDD **100** will deliver media content only to media presentation device **101**. However, newer-generation media presentation devices **101** have the ability to process data received from the Media Distribution Device **100**. Such data may include information pertaining to the presentation of the media content on the media presentation device **101**.

Another example of a media presentation device **101** is a conventional personal computer. The personal computer can receive media content, such as Internet content from the Media Distribution Device **100** and present it to a customer/user. As is well known, a personal computer

can also process data received from the Media Distribution Device **100** to format the presentation of the delivered media content.

The MDD **100** can receive media content and data from one or more sources. In the example of Figure 1, the MDD **100** is depicted receiving media and data from a Media Delivery Service Provider **103**. An example of a Media Delivery Service Provider is a cable T.V. provider, a satellite T.V. provider, an Internet service provider, and a telephone service provider. Notably, the media content and data may be delivered over a single communication link or may be delivered over separate communication links.

In the example of Figure 1, the Media Delivery Service Provider **103** can provide media content and data to the MDD **100** via an Asymmetric Digital Subscriber Line (ADSL) modem **106**. The Media Delivery Service Provider **103** may also provide media content and data to the MDD **100** via a satellite **104**. The satellite can deliver media content and data directly to the MDD **100** over a communications link **122**. Such a direct link usually involves the use of a small satellite dish in conjunction with the MDD **100**. The satellite **104** can also deliver the media content and data to the Media Delivery Service Provider **103** via another communication link **120**. This media content and data may be rerouted to the MDD **100** from the Media Delivery Service Provider **103** over a separate communication link.

The MDD **100** may also have a direct communication link **108** with the Media Delivery Service Provider **103**. Such a link might be a conventional 2400-baud modem connection to the Media Delivery Service

Provider **103**. This communication link **108** may also be a direct hardwire connection or a network connection, such as an Ethernet connection.

In any event, the MDD **100** receives media content and data from a Media Delivery Service Provider **103** and delivers the media content and/or data to the media presentation device **101** for presentation to the customer. Typically, the MDD **100** can communicate in two-directions over the communication links **108** and **124**. That is, the MDD **100** can respond to queries and/or commands received from the Media Delivery Service Provider **103** and return data and/or messages, in response to the receipt of a query or command. The Simple Network Management Protocol (SNMP) is a standard that has been developed to standardize such two-way communication between the MDD **100** and the Media Delivery Service Provider **103**. Typically, an SNMP agent will be installed in the MDD **100** and will coordinate all SNMP communications between the MDD **100** and the Media Delivery Service Provider **103**. Notably, such two-way communications are not currently available over communications link **122** with the satellite **104**.

When a customer associated with the media presentation device **101** experiences a problem, the customer will typically contact a technical support unit associated with the Media Delivery Service Provider **103**. An exemplary embodiment of the present invention permits that remote diagnosis of the MDD **100** and/or the media presentation device **101** by the Media Delivery Service Provider **103**. The Media Delivery Service Provider **103** may also initiate a diagnosis automatically (i.e., without customer initiation). The Media Delivery Service Provider **103** may also use an

exemplary embodiment of the present invention to upload software, media content, and/or data to the Media Distribution Device **100** or the media presentation device **101**. This upload can be automatic or in response to a customer request.

Figure 2 is a block diagram depicting some of the primary components of an exemplary Media Distribution Device. The conventional Media Distribution Device **200** includes a processing unit **221**, a system memory **222**, and a system bus **223** that couples the system memory to the processing unit. The system memory **222** includes read-only memory (ROM) **224** and random access memory (RAM) **225**. A basic input/output system **226** (BIOS) contains rudimentary code to execute basic functions, such as system start-up. The BIOS **226** is stored in the ROM **224**. Various program modules may be stored in the RAM **225**. Such program modules might include an operating system **235**, and intelligent diagnostic agent **236** (such as an SNMP agent), and data and media content **238**.

Although not depicted in Figure 2, the MDD **200** could also include a hard drive or other non-volatile memory for long-term storage of program modules such as the operating system **235**, the intelligent diagnostic agent **236**, and the data and media content **238**. The hard drive may be connected to the MDD **200** via a hard drive interface. Similarly, other peripheral devices could be connected to the MDD with other interfaces not depicted in Figure 2. Moreover, the MDD could also be equipped with an input device, such as keyboard and/or mouse.

The MDD **200** can also include a video adapter **248** or other adapter for delivery of media content and/or data to a media presentation

device **247**. The MDD **200** also includes a Media In Adapter **246** and a Data In Adapter **253**. These adapters permit connection of the MDD **200** to a communication link for one-way and/or two-way communication with a Media Delivery Service Provider. The Media In Adapter **246** and the Data In Adapter **253** may incorporate a modem and/or other communication device.

The MDD **200** receives media content and data and makes the media content and data available to other internal components by way of the system bus **223**. The processing unit **221** can route the media content and/or data in accordance with the instructions of the operating system **235** and/or other applications executed in the RAM **225**. In addition, the processing unit **221** may store the media content and data in the RAM **225** for subsequent use. The processing unit **221** may also direct the media content and/or data to the media presentation device **247** via the presentation device adapter **248**.

The intelligent diagnostic agent **236** may be executed by the processing unit **221** in response to a command received from the Media Delivery Service Provider or any other source. The command may be formatted in accordance with the SNMP protocol. Once the intelligent diagnostic agent **236** has been executed, the agent may perform various system diagnoses to evaluate the performance of the MDD **200**. The intelligent diagnostic agent **236** may then return diagnostic data to the Media Delivery Service Provider identifying the problem or indicating a failure to identify the problem. The Media Delivery Service Provider may return a query for more information or a command to perform a remedial function,

such as downloading a software update from the Media Delivery Service Provider or changing one or more operation parameters of the MDD **200**. Notably, the intelligent diagnostic agent **236** also can be used to perform diagnostic functions on the media presentation device **247** or any other device attached to the MDD **200**. Such a diagnosis may require the Media Delivery Service Provider to query the intelligent diagnostic agent **236** for an identification of the devices connected to the MDD **200**.

Figure 3 is a block diagram depicting a Media Delivery Diagnostic System that is an exemplary embodiment of the present invention. In this exemplary operating environment, the MDD **300** is connected to a hub **316**, which permits the connection of one or more other devices **314**. As described above in connection with Figure 2, the MDD **300** has a resident intelligent diagnostic agent **312**.

The Media Delivery Service Provider **302** has a diagnostic service center **310** associated with it. The diagnostic service center **310** is operative to communicate with the MDD **300** via the satellite **304**, a direct link **308**, and/or a DSL modem **306**. A broadband connection between the Media Delivery Service Provider **302** and the MDD **300** is preferable, because it permits the diagnostic service center **310** to troubleshoot the MDD **300** in real-time and can support an "always-on" connection. Thus, the diagnostic service center can query for and obtain diagnostic information related to the MDD **300** and then send remedial action commands to the intelligent diagnostic agent **312** to remedy the problem within a very short time frame. Low-bandwidth connections, such as the conventional 2400-baud connection **308**, require the diagnostic service center **310** to obtain

diagnostic data that is historical rather than current (i.e., not realtime) and to diagnose the MDD **300** based on historical data, rather than current data. Because a broadband connection can maintain an always-on status, the diagnostic service center can autonomously query the MDD**300** during off-peak hours of operation, thereby reducing the impact on system resources.

Although the broadband connection depicted in Figure 3 is supported by means of an ADSL modem **306**, virtually any broadband technology can be used to implement an exemplary embodiment of the present invention. For example, a conventional broadband cable-T.V. connection between the Media Delivery Service Provider**302** and the MDD **300** can be used. Unfortunately, current broadband cable-T.V. protocols are not as secure as an ADSL broadband communication link. Broadband cable-T.V. signals can be intercepted and deciphered, while the communication link between the ADSL modem**306** and the Media Delivery Service Provider **302** can be implemented as a Private Virtual Network that is not shared by other users. Thus, an ADSL broadband connection between the MDD **300** and the Media Delivery Service Provider **302** is preferred to other available broadband connections.

The Media Delivery Diagnostic System depicted in Figure 3 can be implemented in response to a customer complaint or in an autonomous fashion. When a customer complains to the Media Delivery Service Provider **302**, the complaint can be passed to the diagnostic service center **310**. The diagnostic service center 310 can initiate a query or command and transmit the query or command to the MDD**300**. The query or command may be first processed by an SNMP unit**320** in the diagnostic

service center **310** so that the query or command can be packaged for processing by an intelligent diagnostic agent**312** residing in the MDD **300**. When the intelligent diagnostic agent**312** receives the query or command, it can perform a diagnostic evaluation of the MDD**300**, the hub **316**, and any other devices **314** connected to the MDD. Notably, the ADSL modem**306** may be an integrated component of the MDD **300**. In this case, the intelligent diagnostic agent**312** also could diagnose any problems with the ADSL modem **306**.

The intelligent diagnostic agent **312** can transmit diagnostic data back to the diagnostic service center **310**. The diagnostic data may simply be operational data and/or operational parametersrelated to the MDD **300**, the identification of a problem associated with the MDD**300**, or an indication that the intelligent diagnostic agent failed to identify a problem in the MDD **300**.

In response to the receipt of diagnostic data from the MDD**300**, the diagnostic service center **310** can send a supplemental query or command to instruct the intelligent diagnostic agent **312** to perform a remedial action. For example, the intelligent diagnostic agent may be instructed to download an updated version of an operating system to replace an existing operating system in the MDD **300**. If the problem cannot be remedied, the intelligent diagnostic agent**312** may be instructed to enter the identification of the MDD **300** in a service log for a subsequent arrangement for an on-site technical service call.

Those skilled in the art will appreciate that the intelligent diagnostic agent **312** may work completely autonomously or may interact

with an on-site customer and/or technician. An interactive diagnostic session may involve presenting a user interface over a media presentation device and receiving input from the customer an/or technician via an input device connected to the presentation device or the MDD**300**.

In one embodiment of the present invention, an initial diagnostic step may include a determination of whether the Media Delivery Service Provider **302** is properly communicating with the MDD **300** via the preferred connection. For example, the Media Delivery Service Provider **302** may first check the ADSL modem **306** and/or the ADSL communication link to verify that the Media Delivery Service Provider can properly communicate with the MDD **300**. If the connection is operative, the diagnostic session can proceed. If, on the other hand, the connection is not operative, the Media Delivery Service Provider may attempt to remedy the problem through other communication links, such as through the satellite **304**. For example, the Media Delivery Service Provider might attempt to update the MDD's **300** operating system and/or ADSL modem driver by sending a command to the intelligent diagnostic agent**312** over a one-way communication link between the MDD and the satellite**304**. If such a one-way remedial action fails, the Media Delivery Service Provider may initiate the arrangement of an on-site technician service call.

Figure 4 is a flow chart depicting an exemplary method for providing remote media delivery system diagnostics. It will be appreciated that the method of Figure 4 is simply one embodiment of the present invention for diagnosing a media delivery service system. Those skilled in the art will appreciate that the method may be used for other communication

systems and may be modified to accommodate the various policies of communication system providers. For example, many such communication system service providers would implement various security and/or privacy steps that are not depicted in Figure 4.

The method of Figure 4 starts at step **400** and proceeds to decision block **402**. At decision block **402**, a determination is made as to whether the modem is communicating with the network. In the example of Figure 3, this step may be performed by the diagnostic service center**310** to determine whether the ADSL modem **306** is properly communicating with the Media Delivery Service Provider **302**. If the modem is properly communicating with the network, the method branches to step**404**. At step **404**, the memory of the MDD is examined. This may be the ROM, the RAM or the non-volatile (e.g., hard drive) memory of the MDD. The method proceeds from step **404** to decision block **406**.

At decision block **406**, a determination is made as to whether an intelligent diagnostic agent in the MDD memory is functional. If the intelligent diagnostic agent is functional, the method branches to step**408**. At step **408**, a command is transmitted to the MDD to execute the intelligent diagnostic agent. The method proceeds to step**420**. At step **420**, diagnostic data related to the MDD is collected. The method then proceeds to step**422** and the diagnostic data is analyzed.

The method proceeds from step **422** to decision block **424**. At decision block **424**, a determination is made as to whether an identified problem can be remotely remedied. If the problem can be remedied, the

method branches from decision block **424** to step **426**. At step **426**, the problem is remedied. The method then proceeds to step**428** and ends.

Returning now to decision block **424**, if a determination is made that the problem cannot be remotely remedied, the method branches to step **418**. At step **418**, a technician service call is arranged so that the problem can be remedied by an on-site technician. The method proceeds from step **418** to step **428** and ends.

Returning now to decision block **402**, if a determination is made that the modem is not communicating with the network, the method then branches to step **412**. At step **412**, an attempt is made to upload an intelligent diagnostic agent via satellite link. In an alternative embodiment, the existing intelligent diagnostic agent may be sent a command to re-boot the MDD, to upgrade the operating system, or to perform remedial actions related to the communication link. In any event, an alternative diagnostic procedure is implemented, in response to a failure to communicate with the MDD over the preferred communication link.

The method proceeds from step **412** to decision block **414**. At decision block **414**, a determination is made as to whether the modem is communicating with the network, following the remedial actions taken in step **412**. If the modem is communicating with the network, the method branches to step **404** and proceeds as described below. If the modem is not communicating with the network, the method branches to step **418** and a technician service call is arranged. The method proceeds from step **418** to step **428** and ends.

Returning now to decision block **406**, if a determination is made that the intelligent diagnostic agent is not functional, the method branches to step **410**. At step **410**, an intelligent diagnostic agent is uploaded to the MDD via the modem communication link. The method proceeds to decision block **416**. At decision block **416**, a determination is made as to whether the intelligent diagnostic agent is functional, following the remedial action taken in step **410**. If the intelligent diagnostic agent is not functional, the method branches to step**418** and a technician service call is arranged. If, on the other hand, a determination is made at decision block **416** that the intelligent diagnostic agent is functional, the method branches to step **408** and proceeds as described above.

Although the present invention has been described in connection with various exemplary embodiments, those of ordinary skill in the art will understand that many modifications can be made thereto within the scope of the claims that follow. Accordingly, it is not intended that the scope of the invention in any way be limited by the above description, but instead be determined entirely by reference to the claims that follow.